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ORIGINAL ARTICLE

The development of a clinical practice guideline to improve sleep in intensive care patients: A solution focused approach

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KEYWORDS
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Summary
Objective: Our objective was to develop a guideline to improve the opportunity for intensive care patients to rest and sleep.
Design and setting: A pragmatic solution focused approach to guideline development and implementation was used in which data from international literature and original research from the study ICU were appraised in extensive consultation with intensive care staff. Audits were conducted early in the implementation phase to measure adoption rates.
Results: Over 320 suggestions were made for inclusion in a practice guideline. Information was integrated to create the guideline. A comprehensive 'rest and sleep for the intensive care patient' guideline was developed comprising two main themes: 'Optimise the environment' (for example, 'Quiet conversation') and 'Rest and sleep interventions' (for example, 'Provide optimal conditions for night-time sleep'). Audit data suggested that adoption of the guideline had begun but was not yet embedded in practice.
Conclusion: The solution focused approach to addressing improvements ICU patients' sleep and the consideration of multiple sources of evidence resulted in the development of a comprehensive, context specific guideline. The process, based on a solution focus, may overcome difficulties faced by clinicians endeavouring to improve health care when there is a lack of high level evidence.

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Implications for Clinical Practice

- A solution-focussed approach is a useful method of engaging all personnel in the intensive care unit in improving patient care.
- A pragmatic approach to guideline development including the inclusion of data from patients and suggestions from health care personnel working in the local context may be a method for providing guidance on complex aspects of care in many health care settings.
- Systematic evaluation of practice improvement initiatives is necessary for lessons learned to be applied in other contexts.

Introduction

Clinical practice guidelines (CPG) are frequently used in acute health care settings, such as intensive care units (ICU) to assist decision making and facilitate evidence based practice. Clinical practice guidelines are particularly useful when a complex intervention is required to care for or treat patients more effectively (Craig et al., 2008a). For example to improve sleep for ICU patients, many aspects of practice require attention, such as noise reduction, comfort and pharmacology.

The theory of diffusion of innovations (DOI) of Everett Rogers (2003) has strongly influenced strategies to implement evidence based health care, in particular CPGs (Greenhalgh et al., 2004; Simpson and Doig, 2007) and quality improvement (Titler and Moore, 2010). Briefly, the DOI theory originates from research conducted into the uptake of new agricultural methods (Rogers, 2004). Rogers described diffusion as communication of an innovation between individuals in a social group. The innovation may not actually be 'new'; the important point is that the individual/group perceive it as novel. Rogers used categories to describe an individual's propensity to adopt: innovators, early adopters, early majority, late majority and laggards. The categories provide a schema of potential adopter characteristics for change agents to consider when planning an implementation campaign. The potential adopter's decision to adopt is described in terms of a five step process which is similar to the innovation process within an organisation: (1) agenda-setting (awareness of the need for change), (2) matching (potential solution to a problem is identified), (3) restructuring (the innovation is modified and reinvented and the organisation is adapted to accommodate the innovation), (4) clarifying (unwanted effects of the innovation are resolved) and (5) routinising (the innovation is incorporated in everyday work) (Rogers, 2003).

High level evidence for the adoption of CPGs is lacking, with few studies reporting process of care data (that is whether the patient actually received treatment) together with patient and cost outcomes (Titler, 2010). However two extensive systematic reviews revealed that the use of local consensus to inform guideline content together with multifaceted methods of encouraging adoption is a commonly used CPG implementation strategy (Greenhalgh et al., 2004; Grimshaw et al., 2004). It is likely that multifaceted inclusive approaches incorporating educational input and reminders have a moderate effect on CPG adoption (Greenhalgh et al., 2004; Grimshaw et al., 2001; Simpson and Doig, 2007). This inclusive approach embraces many of the principles underpinning DOI theory, namely awareness raising, reinvention and dissemination through social influence.

Ideally CPGs are systematically developed statements based on high level research evidence, for example randomised controlled trials (RCT). However the lack of research (and RCTs) conducted for many conditions and evidence for the treatment and care of patients leads to difficulties in adhering to this ideal (Forbes and Griffiths, 2002; Titler et al., 2001). This together with indications that CPG acceptance and adoption are increased by content that is specific to the local context leads to the proposition that a more pragmatic approach may be appropriate.

This paper describes the development of a CPG, 'rest and sleep for the intensive care patient', in a tertiary referral hospital in Sydney, Australia. The work was conducted during a study to characterise sleep using polysomnography (PSG) and to assess environmental sound and illuminance levels, as well as events occurring to the patient. The protocol for sleep and environmental monitoring along with some sleep related data have been reported previously (Elliott et al., 2013).

Research using objective and subjective measures of sleep in ICU patients indicates that many patients' sleep is highly fragmented consequently there is a predominance of stage one and two (light) sleep, little slow wave (deep) or rapid eye movement (REM) sleep (Elliott et al., 2013; Friese et al., 2007; Hardin, 2009). Epidemiological studies indicate that poor sleep quality or inadequate sleep time is associated with poor health outcomes (Cappuccio et al., 2011). Therefore there is a pressing need to improve sleep for ICU patients whose sleep is often poor and who need the restorative qualities of sleep.

A CPG was selected in an attempt to improve sleep because there were interrelated facets of the environment, delivery of care and treatment which required improvement. Evidence from recent quality improvement initiatives ('care bundles') in ICU indicates that the sum of several actions can be effective in improving patient outcomes (Jain et al., 2006; Levy et al., 2010). In the study ICU, CPGs were an accepted part of clinical practice therefore the selection of a CPG was anticipated to encourage behavioural and organisational change.

Methods

Objective

Our main objective was to develop and implement a rest and sleep guideline for ICU patients as there was a paucity of published evidence to guide practice.

Setting

The study took place in a 36 bed general, neurosurgical and cardiothoracic adult ICU in a 600 bed metropolitan hospital in Sydney, Australia. This hospital was a tertiary referral facility for specialty services such as cardiac, spinal, renal and burns. The ICU was a closed unit where an accredited ICU staff specialist was responsible for the admission and management of all patients. The Registered Nurse (RN) to patient ratio was one to one for mechanically ventilated patients and one to two or three for patients requiring high dependency care. The RN performed all the care for the patient.

The study ICU was situated three floors above ground level and comprised six open plan six bedded spaces, a three bedded area and two single bed rooms. The outer walls were solid brick and all areas except the two single bed areas had windows which opened to the outside of the building. There was limited intrusive sound from outside of the building except when the emergency air ambulance landed on the roof nearby (approximately weekly).

Participants

Participants were patients treated and health care personnel working in the study ICU. They were volunteers who received no remuneration for participating. Critically ill adults treated in the study ICU were invited to participate if they met the eligibility criteria for sleep data collection that is they were aged >16 years and likely to be treated in ICU for >24 hours and able to give informed consent on their own behalf. Exclusion criteria included: a history of sleep disorders, psychiatric illness requiring medication and a known diagnosis of dementia. The characteristics of the patients ($n = 22$) whose sleep data were shared with the health care personnel were, the mean age was 60 ± 18 years, there were 14 men and nine patients received mechanical ventilation during sleep monitoring. All patients in the ICU on the days the use and uptake of the guideline was audited were included.

There were approximately 200 health care personnel permanently employed to work in the unit and a further 50 health care personnel who provided services such as cleaning and food delivery intermittently at the time the study was conducted. All health care personnel in the study ICU were invited to participate regardless of seniority, role or profession. Over 130 health care personnel contributed to the development of the guideline. The majority were nurses (75%), 10% were medical doctors, a further 10% were ancillary workers (ward clerks, cleaners and care assistants) and 5% were allied health professionals.

Ethical approval

Ethical approval for the entire study was provided by the University (approval number: 2008-292) and Hospital (approval number: 0809-201 M) Human Research and Ethics Committees. Informed consent was gained from patients (written consent was obtained from the patient or their proxy) and health care personnel (verbal consent).

Guideline development

A pragmatic approach to guideline development was undertaken in which all types of evidence were examined. Firstly, an integrative literature review was performed in which observational and interventional research about sleep in ICU patients was examined and the results summarised (Elliott et al., 2011). Secondly, the original sleep, sound, light and event data from the study ICU (Elliott et al., 2013) were examined. The data indicated that there were many opportunities to improve the environment and the way in which clinical care and treatment were delivered. Thirdly, all ICU health care personnel, including ancillary, allied health nursing and medical staff, appraised the data from their unit and were consulted to elicit their suggestions for content of a practice guideline. Finally information from all of these sources was integrated to create a multifaceted CPG ('rest and sleep for the intensive care patient'). The process of guideline development and implementation is described in Fig. 1.

Integrative review

An accepted checklist for performing literature reviews (Meta-analysis Of Observational Studies in Epidemiology) was used to review the international literature (Stroup et al., 2000). The search procedure is described in detail elsewhere (Elliott et al., 2011). Studies reviewed were original investigations of sleep in adult ICU patients containing sleep data derived from polysomnography (PSG) or patient self-reports while the patient was treated in ICU. Studies with broader aims of examining the 'patient experience' of ICU were not considered as they were found to contain information which was not specific enough for guideline development.

The published reports (42 studies) were organised into groups: '24-hour PSG recording', 'overnight PSG recording' and 'methods other than PSG'. All evidence related to improving sleep for ICU patients was noted. Interventions with relatively little or low evidence were considered for inclusion in the guideline if they had a reasonable physiological explanation, for example nocturnal mandatory ventilator respiratory rate settings. Overall most of the studies included were observational studies and had small sample sizes, consequently providing relatively low levels of evidence that is, level 3 and 4 (The Joanna Briggs Institute, 2013). In the absence of any published studies reporting the effect of pharmacological interventions on ICU patients' sleep, the authors chose to advise the clinicians during guideline development of the general sleep literature on this topic.

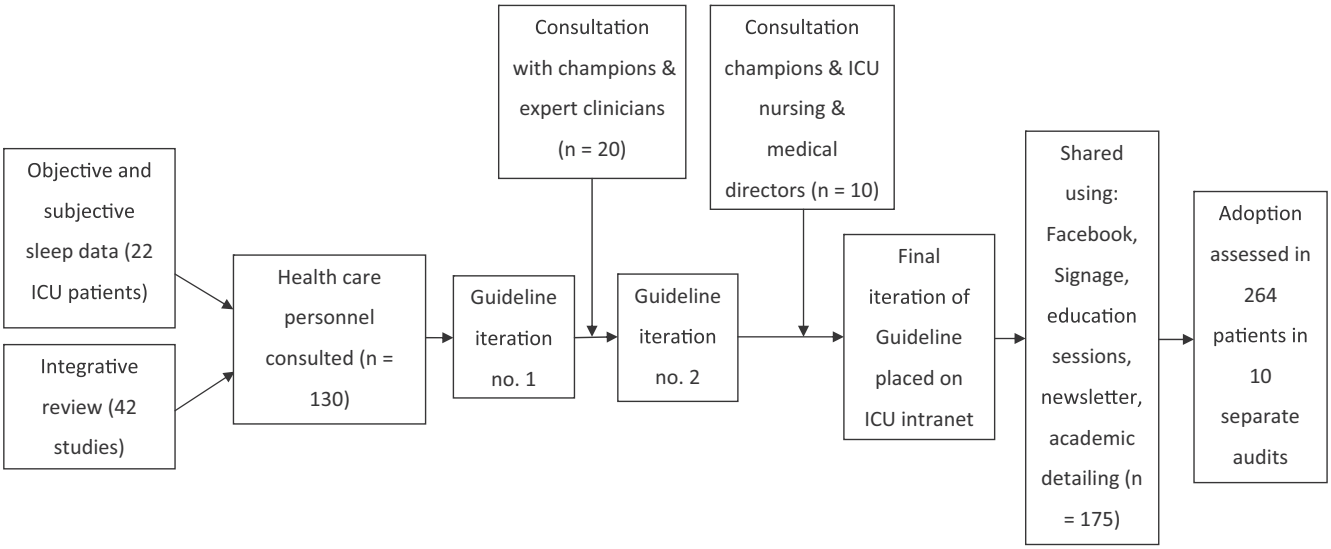

Figure 1 Guideline development and implementation.

Objective sleep data collection

Data were examined from the first 22 patients in our study to characterise sleep using PSG and assess environmental sound and illuminance levels. The PSG data were analysed using conventional sleep staging analysis (Rechtschaffen and Kales criteria (Jasper, 1958)). The main findings were: short total sleep time (mean ± standard deviation (SD): 05:06 ± 4:05 hours), significant sleep fragmentation (mean sleep period without waking: 05:47 ± 09:52 minutes), and little or no slow wave (1%) or rapid eye movement sleep (3%). Environmental monitoring during sleep monitoring revealed intrusive sound levels, for example mean continuous equivalent sound level: LA eq 56.00 ± 2.00 dB and mean peak sound level: 106.00 ± 6.00 dB(C). Illuminance levels were appropriate at night (median: 1.00 (0—515.00) lux) but too dark during the day (median: 74.00 (0.00—977.00) lux) to support normal circadian rhythm. In addition, patients' reports on the quality of their sleep in ICU were poor (mean: 46 ± 28 mm for the Richards Campbell Sleep Questionnaire (Richards et al., 2000)). The factors that patients reported as sleep disruptive were noise (in particular talking) and discomfort (Elliott et al., 2013).

Consultation with health care personnel

Consultation with health care (clinical, ancillary and administrative) personnel was used to build consensus and to contextualise recommendations from international research on sleep in ICU. In terms of DOI theory, consultation comprised 'agenda setting' and 'matching' and was based on a solution-focused technique of group engagement described by Walsh et al. (2005). The approach has been used in action research and practice development in health care settings (Moss and Walsh, 2009; Walsh et al., 2008) to assist facilitators in directing groups to select strategies to develop and implement improvements in the quality of care. The key to the approach described by Walsh et al. (2008) is the choice of language; the word 'puzzle' is used rather than 'problem'; puzzles require workable solutions so that causes of problems become less crucial. There are seven elements in the process: naming the issue, identifying the puzzle, identifying stakeholders and considering the context, identifying the purpose, presenting the evidence, and visualising the future and generating new strategies for action (Walsh et al., 2008).

'Naming the issue' involved presenting the evidence, that is ICU patients' sleep and ICU environmental data, to ICU health care personnel and facilitating discussions. A presentation was made in which sleep, illuminance and sound data were displayed and designed to enable ICU health care personnel to appreciate the main points within 15 minutes. The presentation was used in seven group discussions and more than 60 bedside academic detailing sessions (an informal individualised information session delivered one to one). Consultations were conducted with over 130 ICU health care personnel. At the conclusion of the presentation ICU health care personnel were asked their opinion about the data. The context was considered and all stakeholders' input recognised during discussions. In order to accelerate discussions the following 'puzzles' deliberately focused on the main priorities were presented for personnel to solve. The 'puzzles' presented were:

'The puzzles that need solving

- Intrusive sound levels
- Significant sleep fragmentation
- Reduced slow wave/deep and REM sleep
- Poor quality sleep reported by patients'

At the conclusion of discussions personnel were encouraged to visualise the future and stimulated to suggest new strategies for action. Solution focused questions were posed to generate this discussion:

- 'How best can we give ICU patients the opportunity to rest and experience restorative sleep while in ICU?'
- 'How can we do more of what is done well?'

Health care personnel were in agreement that interrelated facets of the environment, delivery of care and treatment required improvement to increase the opportunity

Table 1 Seven of the most commonly cited themes suggested by health care personnel to improve sleep in ICU patients.

Theme	Frequency
Behavioural activities to reduce sound levels especially at night	72
Cluster care	22
Offer ear plugs and eye shades	19
Afternoon rest period	11
Do not administer personal hygiene at night (2300—0700 hours)	10
Encourage an appropriate circadian rhythm (activities appropriate for the time of day)	9
Respect the patient's usual sleep hygiene routine (if possible)	7

for ICU patients to sleep and rest. They were open to the idea of a guideline to encompass the interventions agreed by the ICU multidisciplinary health care team.

Suggestions were welcomed from all personnel regardless of role or level of seniority. Considerable discussion was generated and more than 320 suggestions to improve rest and sleep were provided. All suggestions to improve rest and promote sleep were documented. Seven of the most commonly cited suggestion themes are presented in Table 1. The first iteration of the guideline involved a process akin to content analysis in which the most frequently cited interventions were included with information from the integrative review. Subsequent iterations comprised small adjustments after consultation with health care personnel who had most expertise for a particular area of the Guideline. For example physiotherapists were consulted about optimising daytime mobilisation strategies, the pharmacist about recommendations for sleep-promoting medications and the cleaners about minimising disruptive noise from floor polishers and emptying rubbish bins. The sleep champions, three informal nurse leaders and an ICU Staff Specialist, consulted their colleagues independently (of the authors) and encouraged them to provide input for each iteration of the Guideline. In addition one or more members of each occupational group of the multidisciplinary ICU team were consulted about each iteration. Consultation at this stage in the process comprised discussions about the overall face validity of the recommendations and the feasibility of using them in the context. There were three iterations of the Guideline.

The sleep champions were requested to verify the final content of the guideline and ensure it was true to discussions. The guideline was endorsed by Director and Nurse Manager of the ICU without modification. The guideline was developed over a two month period.

Guideline implementation

When the guideline was complete and it had been endorsed, it was disseminated amongst the ICU health care personnel. The implementation process continued to follow Rogers' DOI theory (2003) and the recommendations of those experienced in guideline implementation (Greenhalgh et al., 2004; Simpson and Doig, 2007). Multifaceted strategies previously shown to be successful for the adoption of guidelines in the study ICU (Elliott et al., 2006) and the inclusiveness and consultation process used in the development of the guideline continued. Arguably, implementation began when data were fed back to health care personnel. The full guideline was introduced over a two-month period.

Methods designed to reach as many health care personnel as possible as quickly as possible were used to raise awareness. These included: academic detailing discussions at ICU meetings, the guideline was located on the ICU intranet, a place accessible to all ICU health care personnel, reminders were placed in the ICU newsletter, the launch was announced on the social networking website Facebook© (FB), and signage was displayed. Before the daily rest period began signs were placed in the ICU visitors' waiting room outlining the proposed time (1330—1500 hours) and rationale for the rest period.

The aim of the implementation strategy was to reach 80% of health care personnel in one month in order to thoroughly inform the social group (ensure 'early adopter' exposure and acceleration in adoption). To this end more than 100 ICU personnel (approximately 40% of the ICU workforce) were engaged in face to face group sessions or through academic detailing. The sleep champions reached an additional 30% of the workforce using academic detailing. Many more personnel were made aware of aspects of the guideline through more passive methods such as the ICU newsletter and signage.

The implementation of complex interventions requires the collection of process of care and outcome data (Craig et al., 2008b). In the current study the goals were also to provide a measurement of adoption (verify guideline use) and target areas of the guideline that required more emphasis. A summative index was developed and used during process of care audits.

Measuring adoption of the guideline

The method of measuring adoption was adapted from the summative index for pain management described by Titler et al. (2009). The summative index for pain management provided a quantitative evaluation of the quality of this aspect of care in older patients (Titler et al., 2009). Our aim was to develop a reliable method of assessing the extent to which the guideline was in use. The rest and sleep summative index comprised four practices within the guideline that were measurable and thought to be fundamental to the principles of the guideline:

1. Provide optimal conditions for night-time sleep
2. Optimise circadian rhythm
3. Manage pain well
4. Provide a daytime rest period

The extent and use of each practice was assessed using predetermined criteria. The level of care at which they were delivered was determined as 'minimal' (score = 1), 'good' (score = 2) or 'excellent' (score = 3). To be assigned a score of 2 the patient had to have received all aspects of that practice at the 'minimal' level as well as the 'good' level. If a patient received care which did not meet the specified

minimum standard a score of zero was assigned. Data were aggregated and descriptive analysis performed in Excel. The summative indices for all patients and an overall mean value for the entire ICU were calculated. Indices were also produced for each of the four interventions audited.

Auditing began three months into the introduction of the guideline and was conducted every two weeks. A random day between Monday and Friday was chosen on which to perform the audit. Intensive care personnel were unaware that the audit was to be conducted. Each audit was an assessment of the use of the guideline over a 24-hour period for all patients currently treated in ICU.

Results

Guideline development

A comprehensive guideline was developed in which many aspects of care were included to increase ICU patients' opportunity to rest and sleep. The level of evidence was not the primary method used to inform the selection of interventions but we identified the highest level of evidence using 'The JBI approach' (The Joanna Briggs Institute, 2013) reported in the international literature for each section in the Guideline. The final version of the guideline comprised two main themes: 'Optimise the environment' and 'Rest and sleep interventions' (Table 2). There were a number of sections within these themes.

Optimise the environment: This theme comprised strategies to improve the environment; 'Report faulty equipment and fittings', 'Quiet shoe rule', 'Environmental cleaning during daylight hours only', 'Quiet conversation' and 'Lighting is appropriate for the time of day'.

Rest and sleep interventions: This theme comprised advice and strategies focused on the individual needs of the patient; 'Manage pain well', 'Optimise normal circadian rhythm', 'Rest period during daytime hours' and 'Provide optimal conditions for night-time sleep', including the provision of ear plugs and eye shades for patients who wished to use them. The highest level of evidence from the international literature in this theme was three.

Recognising that non-pharmacological practices are not always effective against the myriad of potential sleep disruptions critically ill patients must endure, an additional section was added which contained information about medications. However non-pharmacological practices were emphasised throughout the guideline.

Guideline adoption

The use of the guideline was assessed in 264 patients in the audits which were conducted on 10 separate occasions. Six patients had their care audited more than once and one patient's care was assessed in all ten audits. The summative index ranged from 3.4 to 6.6. The average summative index for all audits was 5.2. Average score for each intervention 'Provide optimal conditions for nighttime sleep', 'Optimise circadian rhythm', 'Manage pain well', and 'Provide a daytime rest period' together with the summative index for each audit are graphically presented in Fig. 2. The intervention that consistently scored highest was 'Optimise circadian rhythm' and the lowest was 'Provide a daytime rest period'. Seventeen patients received care that rated 'good' or better in each intervention. Patients with scores above eight were long term ICU patients with ICU lengths of stay greater than one month. Often these patients had a dedicated team of nurses caring for them to enhance continuity of care. An individualised care plan containing information about daily routines and patient preferences was in use, including sleep hygiene.

Discussion

The solution focused approach to addressing improvements ICU patients' sleep and the consideration of many types of evidence resulted in the development of a comprehensive, context specific Guideline. Audits conducted during implementation suggested that adoption of the guideline had begun.

There were several strengths of the guideline which warrant consideration. These include the use of multiple types of evidence to inform the development and implementation of the guideline and the inclusive method by which the guideline was developed. In the absence of high level research evidence to inform the development of the Guideline, an extensive integrative review of relevant literature, patient sleep data and environmental data, suggestions from health care personnel and feedback from former ICU patients were used. Clinical, ancillary and administrative personnel were consulted for their opinions about the sleep and environmental data collected in the ICU in which they worked. A number of iterations of the guideline occurred after consultation with health care personnel. The process was akin to the verification strategies suggested by qualitative researchers to ensure reliability and validity of data (Morse et al., 2002) and importantly, the feasibility of the interventions in the Guideline. It is likely that all important aspects of improving sleep for ICU patients were included and also that the guideline was highly context specific. Engagement techniques were used to engender a solution focused approach which was nonpunitive and more likely to enhance the interest and commitment of health care personnel than an orientation towards problem solving.

To our knowledge this is one of a few studies reporting an attempt to develop, implement and sustain a CPG on rest and sleep for critically ill patients being treated in an ICU. A previous study conducted in a neurointensive care unit (Scandinavia) used audit and feedback with some success to reduce sleep disturbing factors and noise (Monsén and Edéll-Gustafsson, 2005). In this study sound measurements and the number and type of nursing interventions were recorded before and after the implementation of a behavioural modification programme. Sound levels were recorded but sleep data were not collected. The authors concluded that routinising rest times in which interventions were kept to a minimum resulted in a significant reduction in sleep disturbing events. A position statement from the American Thoracic Society on the Promotion of Respiratory and Sleep/Wake Health and the Care of the Critically Ill in the United States did not refer to sleep within ICU during critical illness (Brown et al., 2009). This is not surprising given the magnitude of the undertaking and the relatively

Table 2 Summary of the contents of the final iteration of the 'rest and sleep guideline'.

Theme	Sections	Examples of interventions	Highest level of evidence (The Joanna Briggs Institute, 2013) for an intervention in each section found in the international literature (example(s))
1. Optimise the environment	Report faulty equipment and fittings	Follow the Hospital guidelines for reporting faulty equipment (trolley wheels etc.) and fittings (door hinges)	None located
	Wear 'quiet' shoes	Styles of shoes which are known to generate noise and shoes with soles that make a squeaky sound should not be worn	None located
	Environmental cleaning during daylight hours only	Environmental cleaners are requested to mop and polish floors between 0700 to 1800 hours in order to reduce the associated disruption to patients. Rubbish containers should be emptied no later than 2200 hours	None located
	Talk quietly	Personnel working in ICU should remind each other to be cognizant of the need for a quiet environment when talking	3 (Aaron et al., 1996; Freedman et al., 1999; Hilton, 1985)
	Ensure lighting is appropriate for the time of day	Blinds should be opened and lights switched on between 0700 hours and 1800 hours with the exception of day time rest times. The main room lights should be turned off before 2300 hours and during the daytime rest time	3 (Hu et al., 2010; Olson et al., 2001; Parthasarathy and Tobin, 2002)
2. Rest and sleep interventions	Manage pain well	Pain assessment and management should be provided according to the ICU pain and sedation management guideline	3 (Broughton and Baron, 1978; Dlin et al., 1971; Frisk and Nordstrom, 2003)
	Optimise normal circadian rhythm	Mobilise in the morning Provide light during daytime and darkness at night Provide reminders about the time of day Provide mental stimulation during daylight hours	3 (Hu et al., 2010)
	Provide a rest period during daylight hours	1330—1500 hours	None located

Table 2 (*Continued*)

Theme	Sections	Examples of interventions	Highest level of evidence (The Joanna Briggs Institute, 2013) for an intervention in each section found in the international literature (example(s))
	Provide optimal conditions for night-time sleep	Assess usual sleep practices Assess sleep in ICU Offer ear plugs and eye shades Prepare for night-time sleep Perform observations at an appropriate frequency Set alarms appropriately/Set mechanical ventilation to encourage night-time sleep Cluster care/Deliver hygiene at appropriate times Explain unavoidable night-time disturbances	3 (Fontaine, 1989; Parthasarathy and Tobin, 2002; Richardson et al., 2007)
3. Consider sleep promoting medication	Benzodiazepines/propofol Non-benzodiazepine hypnotics Antipsychotics Antidepressants	Always consider non-pharmaceutical strategies first Only use sleep promoting medication in the short term	3 (Borbely et al., 1985; Dimsdale et al., 2007; Rabelo et al., 2010)

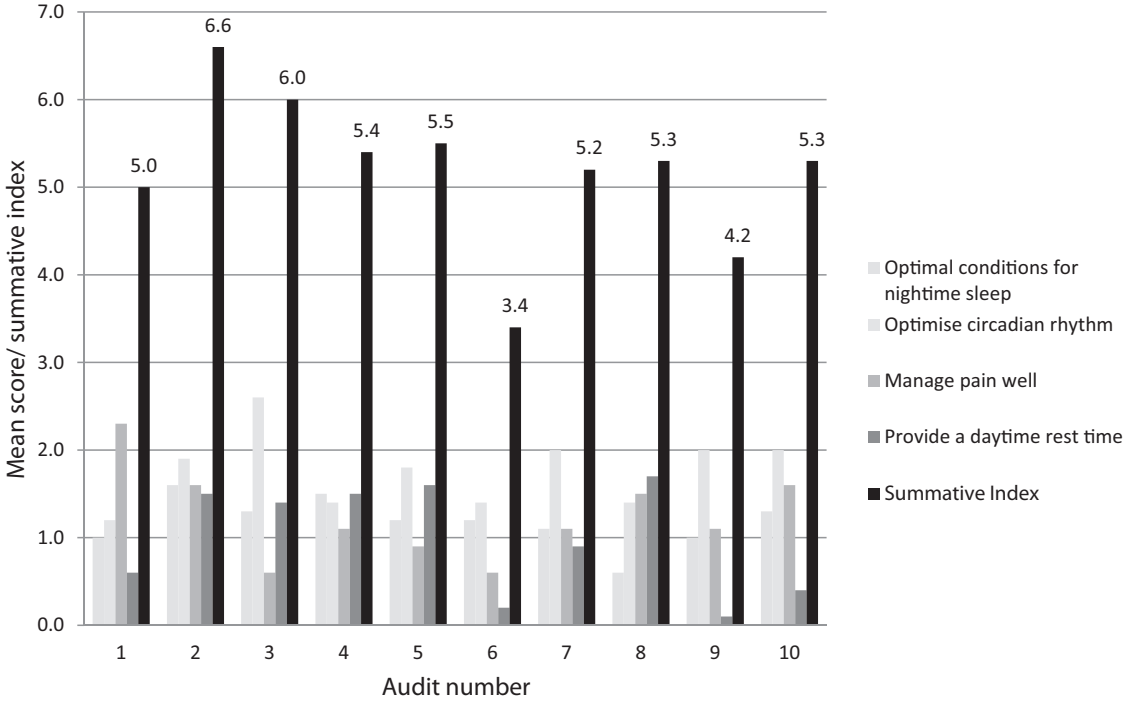

Figure 2 The results of the audit measuring the adoption of the Guideline (mean summative index score).

low levels of evidence on which to base a guideline. Nevertheless the need for better sleep for patients in ICU is evident from PSG and self-report studies (Elliott, McKinley and Cistulli 2011). Sleep is important to patients' comfort while they are in ICU and during recovery, important clinical outcomes in their own right. Sleep disruption may be associated with the delirium frequently observed in ICU patients (Bellapart and Boots, 2012; Trompeo et al., 2011), which in turn has been shown to be associated with worse morbidity (van den Boogaard et al., 2012) and mortality (Ely et al., 2004) outcomes. Poorer outcomes may be mediated in part by the negative effects of sleep deprivation and disruption on the immune, respiratory, muscular and endocrine systems that been described (Dinges et al., 1994; Meier-Ewert et al., 2004; Series et al., 1994). Thus improvement of sleep for the ICU patient is an important clinical goal and may improve patient outcomes. Our endeavour to develop and implement a CPG on patients' rest and sleep in one ICU using the 'puzzling practice' approach is a significant first step towards that goal; evidence from the audits we conducted suggested that clinicians were willing to improve their practice.

The complexity of the guideline and time over which it was developed and implemented were possible limitations. Complexity is highlighted in implementation and DOI research as a potential barrier to adoption (Denis et al., 2002; Grilli and Lomas, 1994; Rogers, 2003) and high level evidence for a guideline is more likely to lead to adoption (Denis et al., 2002). The guideline that resulted from the inclusive development process, at 22 pages containing 10 recommendations, is relatively complex. This complexity and the low level of the underpinning evidence may have mitigated the uptake of the guideline by some clinicians, but due to the lengthy implementation timeframe necessary for CPG sustainability this is yet to be fully evaluated.

The guideline was developed over a two-month period which may have been too brief to gain the opinion and benefit from the experience of over 250 personnel. However great efforts were made to reach as many personnel as possible working in the ICU. The audit results suggest that the guideline was not yet embedded in practice. Although the audits were a useful adjunct to the implementation strategy it was arguably too early in the implementation phase to use the results to evaluate guideline adoption given that some translational researchers suggest that full implementation takes a mean of 17 years (Morris et al., 2011). No specific barriers were identified; low summative index scores for the 'Manage pain well' item were a function of the recently implemented requirement for documentation of two-four hourly pain intensity scores and the patchy occurrence of the 'Provide a daytime rest period' appeared to be purely a result of the number of personnel getting the 'habit' of incorporating the practice in their patient's routine.

Guideline implementation is a lengthy and continuing process that requires feedback on rates of guideline adoption and reinforcement after the initial dissemination, amongst other strategies (Greenhalgh et al., 2004). In the study ICU the initial intense implementation process was followed by incorporation of components of the rest and sleep guideline into the ICU's routine quality improvement programme to promote sustainability (Greenhalgh et al., 2004; Higuchi et al., 2013) beginning with the components on optimisation of the sleep environment and nonpharmacological interventions. In the ICU's quality improvement programme 'sleep' is one of the practices that was routinely audited, recorded in the quality database and reported on at regular quality forum meetings open to all staff. Formal evaluation of the effect of the guideline will be conducted by administration of the self-report instrument, the Richards Campbell Sleep Questionnaire (Richards et al., 2000) used in the PSG study (Elliott et al., 2013) and a self-report study on patient sleep in the same unit prior to guideline implementation (McKinley et al., 2013) in the next 12 months. In the period since the initial work took place the study unit has moved to a new hospital building in which patients are exclusively treated in single rooms therefore the results of this formal evaluation will be particularly interesting.

There remains a pressing need to improve sleep for ICU patients. Given the complexities and challenges involved in assessing sleep in this population (for example the requirement for the presence of trained personnel for PSG monitoring and the inadequacy of the conventional method of scoring sleep when EEG waveforms are abnormal (Watson et al., 2013)) research is required to identify specific states of rest which are easily measured and associated with better patient outcomes. Once this has been established interventional studies are required to facilitate these rest states. In the absence of this evidence environmental and organisational changes which are conducive to rest and sleep should be made to maximise the opportunity for sleep.

The clinical significance of the process of CPG development described in this paper is clear. We believe that the process reported here, based on 'puzzling practice' (Walsh et al., 2008), overcomes difficulties faced by clinicians endeavouring to improve health care when there is a lack of high level evidence. The conventional method of CPG development is not always feasible for areas of health care with little or equivocal research evidence such as improving the quality of sleep for ICU patients. Furthermore as engagement is central to any effort to encourage adoption of new or improved practices (Rogers, 2003) we believe the approach reported may be a useful framework for the introduction of research or new practices in other health care contexts and settings.

Conflict of interest

None declared.

Author contributions

Both authors listed in this paper contributed directly to the work described. The authors conceived the ideas and were responsible for conducting the work together. RE drafted the manuscript and SM performed critical revisions of the manuscript. Funding was obtained by both authors.

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References

Aaron JN, Carlisle CC, Carskadon MA, Meyer TJ, Hill NS, Millman RP. Environmental noise as a cause of sleep disruption in an intermediate respiratory care unit. Sleep 1996;19(9):707—10.

Bellapart J, Boots R. Potential use of melatonin in sleep and delirium in the critically ill. Br J Anaesth 2012;108(4):572—80.

Borbely AA, Mattmann P, Loepfe M, Strauch I, Lehmann D. Effect of benzodiazepine hypnotics on all-night sleep EEG spectra. Hum Neurobiol 1985;4(3):189—94.

Broughton R, Baron R. Sleep patterns in the intensive care unit and on the ward after acute myocardial infarction. Electroencephalogr Clin Neurophysiol/Electromyogr Mot Control 1978;45(3):348—60.

Brown LK, Angus DC, Marin MG, Balmes JR, Barker AF, Ewart G, Halbower AC, Lutz PO, Mularski RA, Nathanson IT, Sanders MH, Stewart GL, Upson DJ. An official American Thoracic Society statement: position statement on ATS activities for the promotion of respiratory and sleep/wake health and the care of the critically ill in the United States. Am J Respir Crit Care Med 2009;180(10):1023—9.

Cappuccio FP, Cooper D, D'Elia L, Strazzullo P, Miller MA. Sleep duration predicts cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. Eur Heart J 2011;32(12):1484—92.

Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: new guidance. Med Res Counc, London 2008a.

Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. British Med J 2008b;337(7676):979—83.

Denis JL, Hebert Y, Langley A, Lozeau D, Trottier LH. Explaining diffusion patterns for complex health care innovations. Health Care Manag Rev 2002;27(3):60—73.

Dimsdale JE, Norman D, DeJardin D, Wallace MS. The effect of opioids on sleep architecture. J Clin Sleep Med 2007;3(1):33—6.

Dinges DF, Douglas SD, Zaugg L, Campbell DE, McMann JM, Whitehouse WG, Orne EC, Kapoor SC, Icaza E, Orne MT. Leucocytosis and natural killer cell function parallel neurobehavioral fatigue induced by 64 hours of sleep deprivation. J Clin Invest 1994;93(5):1930—9.

Dlin BM, Rosen H, Dickstein K, Lyons JW, Fischer HK. The problems of sleep and rest in the intensive care unit. Psychosomatics 1971;12(3):155—63.

Elliott R, McKinley S, Aitken L. Adoption of a sedation scoring system and sedation guideline in an intensive care unit. J Adv Nurs 2006;54(2):208—16.

Elliott R, McKinley S, Cistulli P. The quality and duration of sleep in the intensive care setting: An integrative review. Int J Nurs Stud 2011;48(3):384—400.

Elliott R, McKinley S, Cistulli P, Fien M. Characterisation of sleep in intensive care using 24 hour polysomnography: an observational study. Crit Care 2013;17(2):pR46.

Ely EW, Shintani A, Truman B, Speroff T, Gordon SM, Harrell FE Jr, Inouye SK, Bernard GR, Dittus RS. Delirium as a predictor of mortality in mechanically ventilated patients in the intensive care unit. JAMA 2004;291(14):1753—62.

Fontaine DK. Measurement of nocturnal sleep patterns in trauma patients. Heart Lung 1989;18(4):402—10.

Forbes A, Griffiths P. Methodological strategies for the identification and synthesis of 'evidence' to support decision-making in relation to complex healthcare systems and practices. Nurs Inquiry 2002;9(3):141—55.

Freedman NS, Kotzer N, Schwab RJ. Patient perception of sleep quality and etiology of sleep disruption in the intensive care unit. Am J Respir Crit Care Med 1999;159(4):1155—62.

Friese RS, Diaz-Arrastia R, McBride D, Frankel H, Gentilello LM. Quantity and quality of sleep in the surgical intensive care unit: are our patients sleeping? J Trauma 2007;63(6):1210—4.

Frisk U, Nordstrom G. Patients' sleep in an intensive care unit-patients' and nurses' perception. Intensive Crit Care Nurs 2003;19(6):342—9.

Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: systematic review and recommendations. The Millbank Quarterly 2004;82(4):581—629.

Grilli R, Lomas J. Evaluating the message: the relationship between compliance rate and the subject of a practice guideline. Med Care 1994;32(3):202—13.

Grimshaw JM, Shirran L, Thomas R, Mowatt G, Fraser C, Bero L, Grilli R, Harvey E, Oxman A, O'Brien MA. Changing provider behavior: an overview of systematic reviews of interventions. Med Care 2001;39(8 Suppl 2):II2—45.

Grimshaw JM, Thomas RE, MacLennan G, Fraser C, Ramsay CR, Vale L, Whitty P, Eccles MP, Matowe L, Shirran L, Wensing M, Dijkstra R, Donaldson C. Effectiveness and efficiency of guideline dissemination and implementation strategies. Health Technol Assess 2004;8(6, pp. iii-iv):1—72.

Hardin KA. Sleep in the ICU: potential mechanisms and clinical implications. Chest 2009;136(1):284—94.

Higuchi KS, Downey A, Davies B, Bajnok I, Waggott M. Using the NHS sustainability framework to understand the activities and resource implications of Canadian nursing guideline early adopters. J Clin Nurs 2013;22(11—12):1707—16.

Hilton BA. Noise in acute patient care areas. Res Nurs Health 1985;8(3):283—91.

Hu RF, Jiang XY, Zeng YM, Chen XY, Zhang YH. Effects of earplugs and eye masks on nocturnal sleep, melatonin and cortisol in a simulated intensive care unit environment. Crit Care 2010;14(2):pR66.

Jain M, Miller L, Belt D, King D, Berwick DM. Decline in ICU adverse events, nosocomial infections and cost through a quality improvement initiative focusing on teamwork and culture change. Qual Saf Health Care 2006;15(4):235—9.

Jasper HH. (Committee Chairman) Report of the committee on methods of clinical examination in electroencephalography: 1957. Electroencephalogr Clin Neurophysiol 1958;10(2):370—5.

Levy MM, Dellinger RP, Townsend SR, Linde-Zwirble WT, Marshall JC, Bion J, Schorr C, Artigas A, Ramsay G, Beale R, Parker MM, Gerlach H, Reinhart K, Silva E, Harvey M, Regan S, Angus DC. The Surviving Sepsis Campaign: results of an international guideline-based performance improvement program targeting severe sepsis. Intensive Care Med 2010;36(2):222—31.

McKinley S, Fien M, Elliott R, Elliott D. Sleep and psychological health during early recovery from critical illness: An observational study. J Psychosom Res 2013;75(6):539—45.

Meier-Ewert HK, Ridker PM, Rifai N, Regan MM, Price NJ, Dinges DF, Mullington JM. Effect of sleep loss on C-reactive protein, an inflammatory marker of cardiovascular risk. J Am Coll Cardiol 2004;43(4):678—83.

Monsén MG, Edéll-Gustafsson UM. Noise and sleep disturbance factors before and after implementation of a behavioural modification programme. Intensive Critic Care Nurs 2005;21(4):208—19.

Morris ZS, Wooding S, Grant J. The answer is 17 years, what is the question: understanding time lags in translational research. J R Soc Med 2011;104(12):510—20.

Morse JM, Barrett M, Mayan M, Olson K, Spiers J. Verification Strategies for Establishing Reliability and Validity in Qualitative Research. Int J Qual Methods 2002;1(2):13—22.

Moss C, Walsh K. Solving the puzzle. Caring for older people in ED. Aust Nurs J 2009;16(7):p34.

Olson DM, Borel CO, Laskowitz DT, Moore DT, McConnell ES. Quiet time: a nursing intervention to promote sleep in neurocritical care units. Am J Critic Care 2001;10(2):74—8.

Parthasarathy S, Tobin MJ. Effect of ventilator mode on sleep quality in critically ill patients. Am J Respir Crit Care Med 2002;166(11):1423—9.

Rabelo FA, Braga A, Kupper DS, De Oliveira JA, Lopes FM, de Lima Mattos PL, Barreto SG, Sander HH, Fernandes RM, Valera FC. Propofol-induced sleep: polysomnographic evaluation of patients with obstructive sleep apnea and controls. Otolaryngol -Head and Neck Surg 2010;142(2):218—24.

Richards KC, O'Sullivan PS, Phillips RL. Measurement of sleep in critically ill patients. J Nurs Meas 2000;8(2):131—44.

Richardson A, Allsop M, Coghill E, Turnock C. Earplugs and eye masks: do they improve critical care patients' sleep? Nurs Critic Care 2007;12(6):278—86.

Rogers EM. Diffusion of Innovations. 5th edn New York: Free Press; 2003.

Rogers EM. A prospective and retrospective look at the diffusion model. J Health Comm 2004;9(Suppl 1):13—9.

Series F, Roy N, Marc I. Effects of sleep deprivation and sleep fragmentation on upper airway collapsibility in normal subjects. Am J Resp Critic Care Med 1994;150(2):481—5.

Simpson F, Doig GS. The relative effectiveness of practice change interventions in overcoming common barriers to change: a survey of 14 hospitals with experience implementing evidence-based guidelines. J Eval Clin Pract 2007;13(5):709—15.

Stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, Moher D, Becker BJ, Sipe TA, Thacker SB. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group', JAMA: the Journal of the American Medical Association 2000;283(15):2008—12.

The Joanna Briggs Institute 2013, The JBI Approach, The Joanna Briggs Institute and University of Adelaide, Adelaide, South Australia, viewed 05/12/2013 2013, <http://joannabriggs.org/jbi-approach.html#tabbed-nav=Levels-of-Evidence>.

Titler MG. Translation science and context. Res Theory Nurs Pract 2010;24(1):35—55.

Titler MG, Herr K, Xie XJ, Brooks JM, Schilling ML, Marsh JL. Summative index: Acute pain management in older adults. Appl Nurs Res: ANR 2009;22(4):264—73.

Titler MG, Kleiber C, Steelman VJ, Rakel BA, Budreau G, Everett LQ, Buckwalter KC, Tripp-Reimer T, Goode CJ. The Iowa Model of Evidence-Based Practice to Promote Quality Care. Crit Care Nurs Clin North Am 2001;13(4):497—509.

Titler MG, Moore J. Evidence-based practice: a civilian perspective. Nurs Res 2010;59(1 Suppl):S2—6.

Trompeo AC, Vidi Y, Locane MD, Braghiroli A, Mascia L, Bosma K, Ranieri VM. Sleep disturbances in the critically ill patients: role of delirium and sedative agents. Minerva Anestesiol 2011;77(6):604—12.

van den Boogaard M, Schoonhoven L, Evers AW, van der Hoeven JG, van Achterberg T, Pickkers P. Delirium in critically ill patients: impact on long-term health-related quality of life and cognitive functioning. Crit Care Med 2012;40(1):112—28.

Walsh K, Lawless J, Moss C, Allbon C. The development of an engagement tool for practice development. Practice Development in Health Care 2005;4(3):124—30.

Walsh K, Moss C, Lawless J, McKelvie R, Duncan L. Puzzling practice: a strategy for working with clinical practice issues. Int J Nurs Prac 2008;14(2):94—100.

Watson PL, Pandharipande P, Gehlbach BK, Thompson JL, Shintani AK, Dittus BS, Bernard GR, Malow BA, Ely EW. Atypical Sleep in Ventilated Patients: Empirical Electroencephalography Findings and the Path Toward Revised ICU Sleep Scoring Criteria. Crit Care Med 2013;41(8):1958—67.